OPERATING INSTRUCTIONS

A 32D

FOR ALNOR SERIES 6000-P VELOMETER®

SERIES 6000-P

ALNOR®
INSTRUMENT COMPANY

ALNOR INSTRUMENT COMPANY

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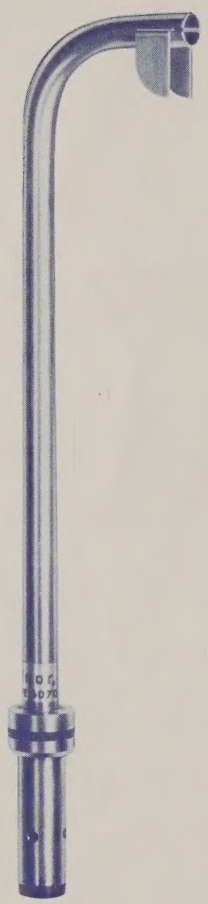
INSTRUMENTS FOR MEASUREMENT AND CONTROL

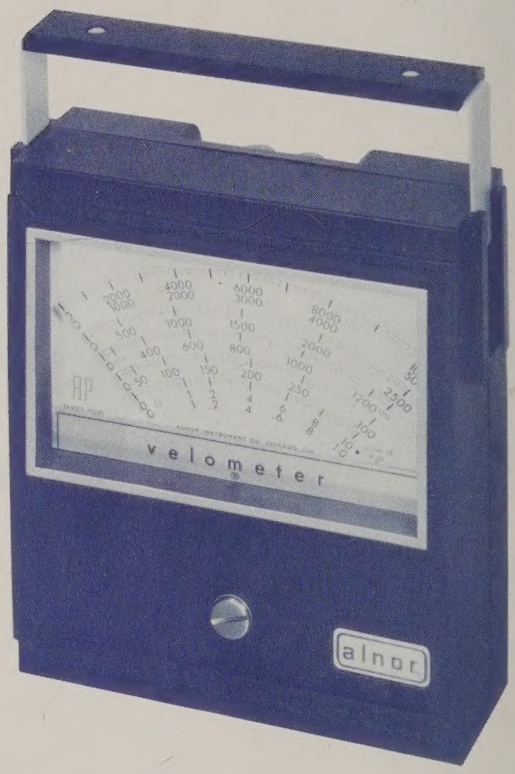
TEMPERATURE • PRESSURE • FLOW • HUMIDITY

FORM 6270

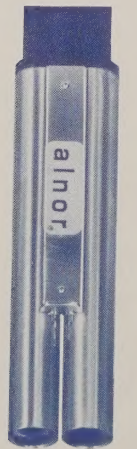
PITOT
PROBE



DIFFUSER
PROBE



SERIES 6000
VELOMETER



LO-FLO
PROBE

STATIC
PRESSURE PROBE

RANGE
SELECTOR

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(1) INTRODUCTION

The Alnor Velometer is a direct reading type instrument to measure flow velocities of air. It permits instant and precise measurement in unrestricted areas or in duct systems. It is also suited to measure static and total pressure. The Alnor Velometer design is based on decades of extensive research by Alnor Instrument Company. Many design features of the Alnor Velometer are patented. The Velometer design patents are United States Patent Number 3,463,003, Great Britain Patent Number 754,894. Other patents are pending. The areas where the Alnor Velometer finds primary use include:

- Heating Systems
- Ventilating Systems
- Air-conditioning Systems
- Air Pollution Studies
- Chemical Process Industry
- Research and Development

(2) DESCRIPTION

GENERAL: The Alnor Velometer is a complete self-contained instrument to measure velocities either in unrestricted space or in ducts. It is also suited to measure static pressure. The Velometer consists basically of the meter, measuring probes, range selectors and connecting hoses.

VELOMETER: The Velometer is basically an air flowmeter. The Velometer is calibrated in velocity units. It is based on the Pitot Tube principle. Pressure exerted on a vane traveling in a circular tunnel causes a pointer to indicate the measured value on a scale.

The Velometer utilizes a taut band movement which is carefully balanced, permitting the use of the instrument in any normal position. The developed length of the meter indicating arc is five inches. All instruments are uniformly calibrated to predetermined standards to achieve interchangeability. Three Velometers are available calibrated in English units, and three Velometers are available calibrated in metric units. The Alnor Velometer is a compact, light-weight instrument. It is easy to hold and is provided with a retractable handle.

(3) MEASURING PROBES AND PREPARATION FOR USE

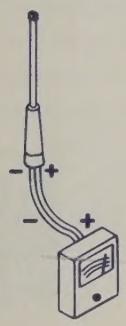
GENERAL: There is no preparation required in reading a Velometer with the exception of connecting the Probe to the Range Selector and to interconnect the Range Selector with the hoses to the Velometer.

VELOMETER: (Type 6006-P) The Velometer is ready for use, however the caps on both ports should be removed. Check the zero adjustment periodically. This is done with both ports closed. In case the pointer does not indicate zero, the zero adjustment screw on the front of the case should be turned slowly until the pointer indicates zero.

The Velometers are calibrated to read station velocities – regardless of barometric pressures.

The Velometer design permits the instrument to remain within its limits of calibration when used in its normal position and throughout a wide range of environmental conditions without the need of correction of the readings.

PITOT PROBE: The Pitot Probe (Type 6060-P) is a general purpose measuring probe primarily suitable for measurements of velocities at supply openings, return openings and velocity measurements within ducts. Maximum temperature 700° F. Insert the Pitot Probe into the Range Selector of the appropriate range in which the Probe is to be used. Push the Pitot Probe firmly down until the collar of the Probe rests against the face of the Range Selector counterbore. In order to permit the rotation of the Probe in the Range Selector it is advisable to apply a thin film of Silicone grease to the Pitot Probe o-ring. Connect the Range Selector by means of the two hoses to the Velometer. Care should be given to connect the fittings on the Range Selector and the fittings of the Velometer which are identified as positive (+) and as negative (—) in the appropriate polarity. The push button on the Range Selector Air Vent Switch to be in its normally closed position (button up and out.)



LO-FLOW PROBE: The Lo-Flow Probe (Type 6050-P) is intended to be used in the velocity measuring ranges of 30-300 FPM or 0.15-1.5 M/S. The Lo-Flow Probe is particularly suited for the direct measurement of drafts in rooms or open spaces and to measure face velocities at ventilating hoods, spray booths or similar applications. The Lo-Flow Probe is directly connected to the Velometer by placing it onto the 2 fittings provided on the Velometer. No hose is required. The Lo-Flow Probe fits only one way onto the Velometer, that is with the arrow on the Probe head pointing to the left when viewing the Velometer from the front. A filter is built in to protect the Velometer.

DIFFUSER PROBE: The Diffuser Probe (Type 6070-P) is primarily designed for measuring the output of diffusers. Snap-off fins are provided to make it possible to accurately position the probe vertically, horizontally and radially. "K" factors developed by the diffuser manufacturer for the 2220A jet on the Type 3002 Velometer are all applicable for both supply and return applications.

STATIC PRESSURE PROBE: The Static Pressure Probe (Type 6080-P) should be positioned carefully over an opening in the wall of a duct so that a positive seal is made at the edge of the rubber cup. The minimum opening required to make accurate pressure measurements is a one-quarter inch (¼") drilled hole.

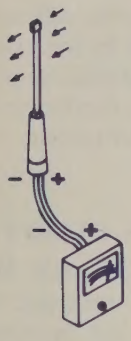
MEASURING RANGE SELECTORS: The Range Selector (Type 6030-P) incorporates calibrated symmetrical restrictors and a range selecting arrangement permitting the rapid change of measuring ranges. An Air Vent Switch Button is provided for use with the 6070-P Diffuser Probe and the 6080-P Static Pressure Probes. This button is pushed in and latched down when used with the Diffuser and Static Pressure Probes only. When using the Pitot Probes (Type 6060-P) the button must be released to its normal position (up and out). A filter is built in to protect the Velometer and Range Selector restrictors.

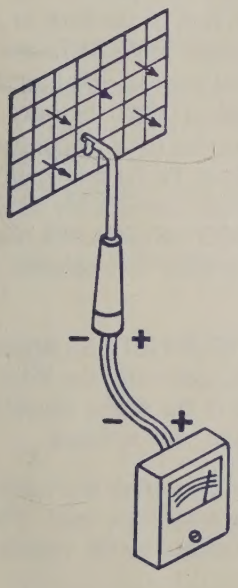
The 6030-P Range Selectors are provided with quick plug-in ports which accept the various probes and allows the probes to be rotated 360°. They are also provided with fittings for connection to the Velometer.

Four Range Selectors are available for Velometer's calibrated in English units and four Range Selectors are available for Velometers calibrated in metric units. Read the range indicated by the Range Selector.

It is possible, thru normal wear, that the Range Selector Switch Plate may work loose and cause leaks. This looseness can be corrected by tightening the "Take-up" Adjustment Screw which is located between the two hose fittings on the lower Switch Housing Assembly. (Refer to page 12 on Maintenance.)

A noticeable effort to change range will indicate proper tightness.





(4) METHODS OF MEASUREMENT

VELOCITIES IN OPEN SPACES

LO-FLOW PROBE: In using the Velometer with a Lo-Flow Probe for measuring velocities in open spaces, measurements can be performed within the ranges of 30–300 ft/min or 0.15–1.5 m/sec. The instrument should be held so that the pointer on the head of the Lo-Flow Probe points in the same direction as the flow to be measured. In case the direction of flow is unknown, turn the instrument slowly until the maximum reading is obtained.

PITOT PROBE: When measuring with a Pitot Probe, velocities in the range from 100 – 10 000 ft/min or 0.5 – 50 m/sec can be measured. If however the measured velocity would fall within the range of 100 – 300 ft/min or 0.5 – 1.5 m/sec, it is advisable to utilize the Lo-Flow Probe to achieve greater accuracy. When most of the readings fall within the range above 300 ft/min or 1.5 m/sec, measurements with the Pitot Probe are more convenient by eliminating the need for changing the Probe. In case the direction of flow is unknown, rotate the Pitot Probe slowly to obtain a maximum reading, and the arrow on the Pitot Probe will then indicate the direction of flow. Range Selector Vent Switch Button must be in normal position (up and out). Maximum temperature 700° F.

AIR VELOCITIES AT SUPPLY OPENINGS: To measure air velocities at supply openings utilizing the 6070-P Probe plug probe into an appropriate Range Selector and connect to the Velometer with the two single hoses. Air Vent Push Button Switch down and latched in.

Some manufacturers have calculated "K" factors to compute volume output of their grilles. In this situation it is recommended that the 6070-P Probe be positioned exactly as instructed by the manufacturer.

When it is desired to determine the volume output of an opening having no grille, utilize the following equation:

$$Q = AV$$

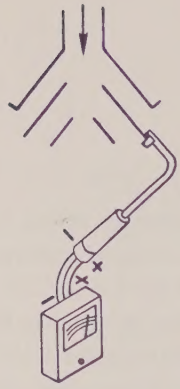
where Q = flow rate in cubic ft. /min. or cubic MPS

A = area in square ft. or square meters

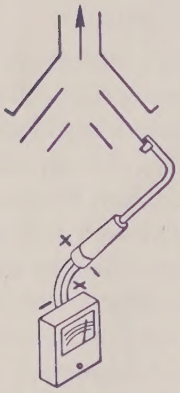
V = average velocity in FPM or MPS

If the opening is covered by a grille and a manufacturers "K" factor is not available it is suggested that the 6070-P Probe be positioned 1" down-stream from the face of the grille.

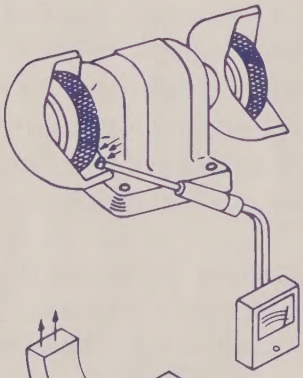
To determine average velocity divide the opening into a number of equal areas. Take a single reading at the center of each. Generally 6 to 20 readings are adequate. When this is done "A" in the above equation is the core area.

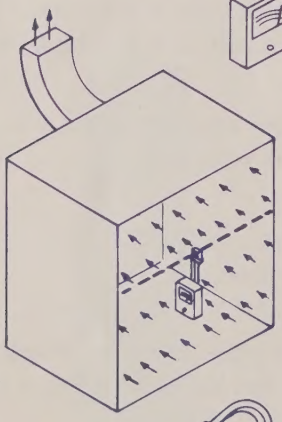


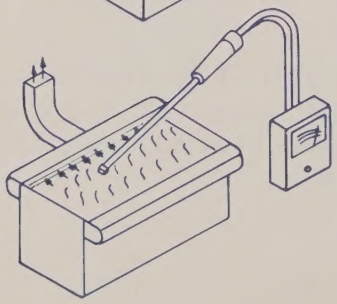
Diffuser Supply



Diffuser Return







DIFFUSER APPLICATION: To determine the output of a ceiling diffuser use the Diffuser Probe 6070-P plugged into the appropriate Range Selector and connect to the Velometer with the two single hoses.

Depress the Air Vent Switch Button in and down to latch! By means of the two single hoses connect the Range Selector to the Velometer as follows:

For supply measurements connect the plus (+) fitting of the Velometer to the plus (+) fitting of the Range Selector and the minus fitting (—) of the Range Selector to the minus (—) fitting of the Velometer. For return measurements connect the plus (+) fitting of the Range Selector to the minus (—) fitting of the Velometer and the plus (+) fitting of the Velometer to the minus (—) fitting of the Range Selector.

To compute the volumetric output of the diffuser multiply the average reading by the "K" factor established by the manufacturer. NOTE. The "K" factor established by the manufacturer for the 2220-A jet and 3002 Velometer are also applicable to the 6070-P Diffuser Probe for both supply and return situations.

$$Q = KV$$

VELOCITIES AT SUCTION OPENINGS – EXCEPT DIFFUSERS

AT RETURN OR EXHAUST OPENINGS: When measuring the velocities at return or exhaust openings, velocities from 100 to 10,000 FPM or 0.5 to 50 MPS can be measured with the 6060-P Pitot Probe.

The Pitot Probe should be held with the arrow on the tube of the Pitot Probe pointing in the direction of the flow to be measured; that is, the arrow should point TOWARD the suction opening. The Pitot Probe should be held parallel and as close to the grille as possible if such a grille is used to cover the opening.

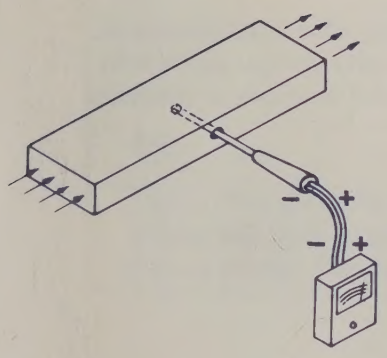
NOTE: Some grille manufacturers have established "K" factors applicable to the 6070-P Diffuser Probe and their grilles for return service! Connect Velometer and accessories for diffuser return service as described above in DIFFUSER APPLICATION. Be sure to position the 6070-P Probe exactly as instructed by the grille manufacturer.

AT GRINDING OR BUFFING WHEELS: When measuring velocities at grinding or buffing wheels, generally the Pitot Probe or the Lo-Flow can be used. The head of the probe should be held in a plane defined by the rim of the suction hood.

AT SPRAY BOOTHS: When measuring the velocity at spray booths generally the Lo-Flow Probe will be used. The head of the probe should be placed in a plane defined by the outside entry edge of the spray booth.

VELOCITIES AT PLATING TANKS: To measure the velocity at plating tanks, generally the Pitot Probe is used. The Pitot Probe should be held close to the exhaust port of the tank with the arrow on the tube of the probe pointing toward the exhaust port.

VELOCITIES INSIDE OF DUCTS



To measure velocities inside of ducts, use the Pitot Probe. It is necessary to have an opening in the duct wall available. In case there is no opening provided, a hole of 5/8 in. in diameter must be drilled for insertion of the Pitot Probe. The Pitot Probe is to be inserted into the duct. The arrow on the tube of the Pitot Probe must point in the same direction as the flow inside the duct.

Since air velocities are rarely uniform within the entire cross section area of the duct, it is necessary to determine the average velocity. In general, the greater the number of readings taken, the better the accuracy which will be achieved in calculating the average velocity. In order to determine the location of individual measuring points, the Pitot Probe is provided with calibrations. The insertion distance of the Pitot Probe is indicated along the outside of the Pitot Probe. Maximum temperature 700° F.

In measuring the velocity inside of the duct, it is important to select a location where the flow is more uniform and where there is little turbulence. The best locations to measure are usually along straight runs of duct. Measurements should preferably be made at 10 duct diameters down stream from the nearest turn, transformation, damper, or other source of turbulence.

AIR VOLUME INSIDE OF DUCTS: To calculate the air volume passing through ducts, it is necessary first to calculate the average velocity inside the duct, based on the measurements of the flow velocities within various parts of the duct cross-section. Then the cross-section of the duct must be calculated and then, based on the average velocity and the cross-section area of the duct, the air volume passing through the duct can be calculated.

Use the following equation:

$$Q = A \cdot V$$

Where

		Engilsh Units	Metric Units
Q	Quantity of air	ft^3/min	m^3/s
A	Cross-section area	ft^2	m^2
V	Average flow velocity	ft/min	m/s

To calculate the average velocity within a duct, several methods can be utilized.

Since air velocities are rarely uniform across a duct, it is necessary to determine the average velocity. Measurements should be made at the centers of equal areas. In general, the greater the number of readings taken the better the accuracy will be.

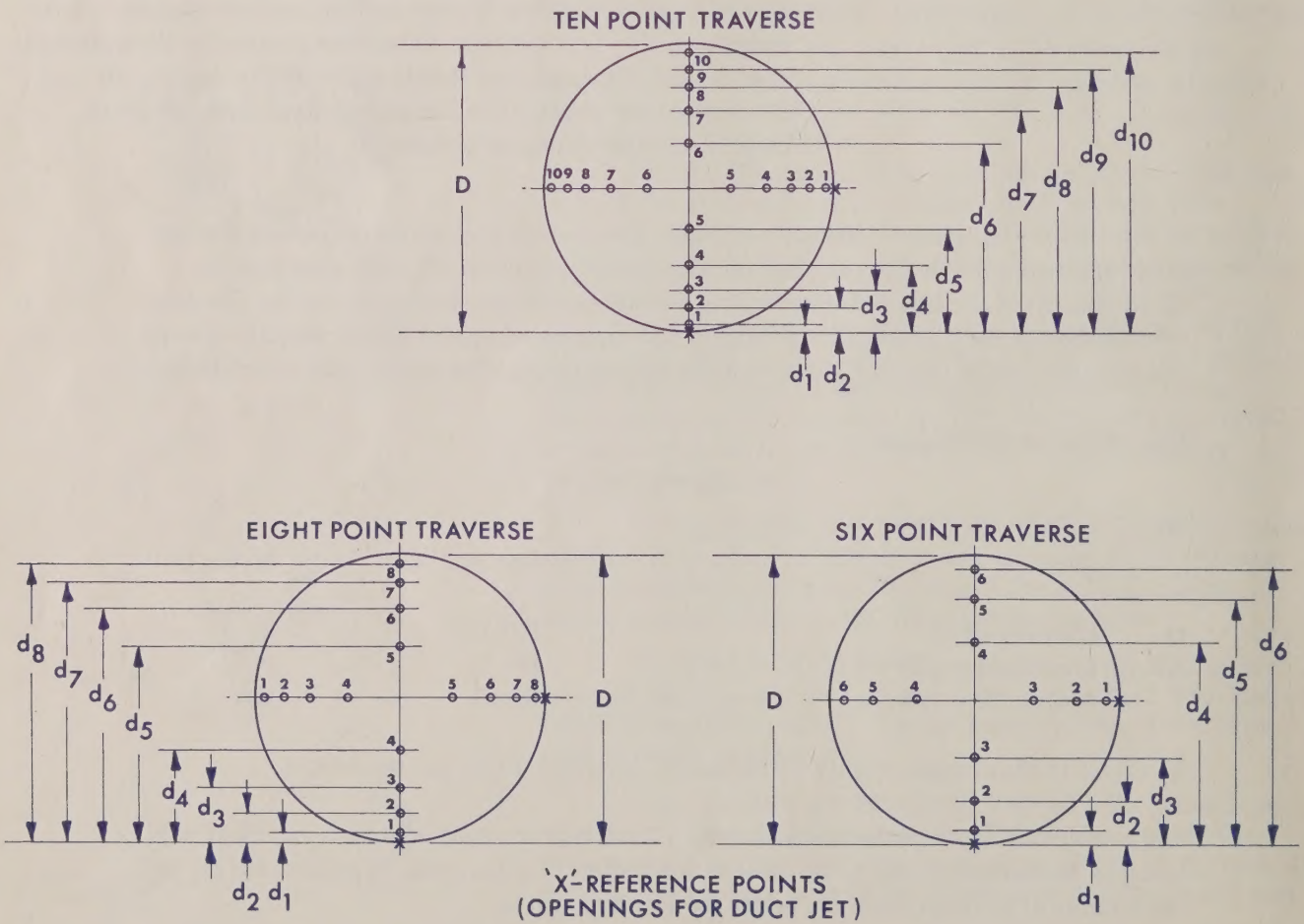
For rectangular ducts, mentally divide the duct into at least nine equal areas (preferably more) that are approximately square. Take readings at the centers of these areas and average them.

For round ducts, a total of 20 readings is the best practice; 10 readings across each of two diameters at right angles to each other.

A quicker, though less accurate method, may be used for field testing when a straight run of duct of at least 10 diameters is available. Never use this method if such a straight run of duct is not available. Take a single center line reading and multiply it by 0.9 to obtain an estimated average velocity.

In a circular duct it is advisable to use a traversing method whereby the entire duct cross-section area is divided into a number of concentric ring sections of equal area. The center distances of the individual areas have been calculated for 6, 8 and 10 point traverses and are tabulated in the following tables:

6, 8 AND 10 POINT TRAVERSE METHOD



A traverse should be made across two perpendicular diameters.
For the 6, 8 and 10 point traverse method, the distance from the reference point for a variety of duct diameters have been calculated. Figure 1 shows the distance of the individual measuring points from the reference point expressed in pipe diameters. Figures 2, 3 and 4 show the distance of the individual measuring points from the reference point expressed in inches. These dimensions are equivalent to the probe immersion distance.

Traverse Method ➡	Probe immersion in Duct Diameters									
	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	d_9	d_{10}
6 point	0.043	0.147	0.296	0.704	0.853	0.957	–	–	–	–
8 point	0.032	0.105	0.194	0.323	0.677	0.806	0.895	0.968	–	–
10 point	0.025	0.082	0.146	0.226	0.342	0.658	0.774	0.854	0.918	0.975

FIGURE 1

Duct. Dia. (In.)	Probe immersion for 6 pt. traverse					
	d_1	d_2	d_3	d_4	d_5	d_6
10	3/8	1-1/2	3	7	8-1/2	9-5/8
12	1/2	1-3/4	3-1/2	8-1/2	10-1/4	11-1/2
14	5/8	2	4-1/8	9-7/8	12	13-3/8
16	3/4	2-3/8	4-3/4	11-1/4	13-5/8	15-1/4
18	3/4	2-5/8	5-3/8	12-5/8	15-3/8	17-1/4
20	7/8	3	6	14	17	19-1/8
22	1	3-1/4	6-1/2	15-1/2	18-3/4	21
24	1	3-1/2	7-1/8	16-7/8	20-1/2	23

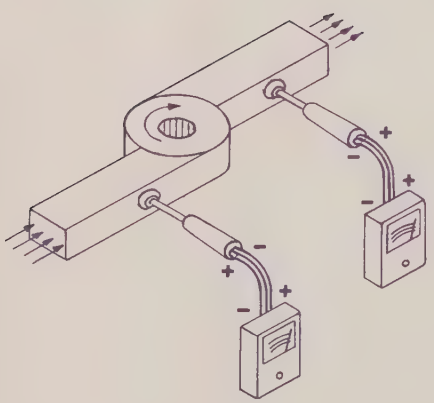
FIGURE 2

Duct. Dia. (In.)	Probe immersion for 8 pt. traverse							
	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8
10	5/16	1	2	3-1/4	6-3/4	8	9	9-5/8
12	3/8	1-1/4	2-3/8	3-7/8	8-1/8	9-5/8	10-3/4	11-1/2
14	7/16	1-1/2	2-3/4	4-1/2	9-1/2	11-1/4	12-1/2	13-1/2
16	1/2	1-5/8	3-1/8	5-1/8	10-7/8	12-7/8	14-3/8	15-1/2
18	9/16	1-7/8	3-1/2	5-7/8	12-1/4	13-1/2	16-1/8	17-1/2
20	5/8	2-1/8	3-7/8	6-1/2	18-1/2	16-1/8	17-7/8	19-3/8
22	11/16	2-3/8	4-1/4	7-1/8	14-7/8	17-3/4	19-3/4	21-1/4
24	3/4	2-1/2	4-5/8	7-3/4	16-1/4	19-1/2	21-1/2	23-1/4

FIGURE 3

Duct. Dia. (In.)	Probe immersion for 10 point traverse									
	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	d_9	d_{10}
10	1/4	7/8	1-1/2	2-1/4	3-3/8	6-5/8	7-3/4	8-1/2	9-1/8	9-3/4
12	1/4	1	1-3/4	2-3/4	4-1/8	7-7/8	9-1/4	10-1/4	11	11-3/4
14	3/8	1-1/8	2	3-1/8	4-3/4	9-1/4	10-7/8	12	12-7/8	13-5/8
16	3/8	1-1/4	2-3/8	3-5/8	5-1/2	10-1/2	12-3/8	13-5/8	14-3/4	15-5/8
18	1/2	1-1/2	2-5/8	4-1/8	6-1/8	11-7/8	13-7/8	15-3/8	16-1/2	17-1/2
20	1/2	1-5/8	2-7/8	4-1/2	6-7/8	13-1/8	15-1/2	17-1/8	18-3/8	19-1/2
22	1/2	1-3/4	3-1/4	5	7-1/2	14-1/2	17	18-3/4	20-1/4	21-1/2
24	5/8	2	3-1/2	5-3/8	8-1/4	15-3/4	18-5/8	20-1/2	22	23-3/8

FIGURE 4



STATIC PRESSURE MEASUREMENTS

To use the Static Pressure Probe depress the Air Vent Switch Button on Range Selector IN and DOWN to latch. Plug the Static Pressure Probe into the Range Selector. Using the two single hoses provided connect the Range Selector to the Velometer as follows: For positive pressures connect the plus (+) port of the Velometer to the plus (+) port of the Range Selector and the minus (—) port of the Range Selector to the minus (—) port of the Velometer.

For negative pressures connect the plus (+) port of the Range Selector to the minus (—) port of the Velometer and the minus port of the Range Selector to the plus port of the Velometer. The Range Selector Switch should be positioned to the extreme left under the low range and static pressure setting.

MEASUREMENT IN CORROSIVE ATMOSPHERES

Although the Alnor Velometer is not intended for use in corrosive atmospheres, a very brief intermittent exposure in the process of measurement in a corrosive atmosphere will not harm the Velometer.

TEMPERATURE CORRECTIONS FOR MEASUREMENTS: When measuring velocities, a change in atmospheric pressure or in the density of the test gas or environment in which the Velometer is used will not appreciably change the readings. A temperature differential between the test gas and the medium surrounding the Velometer itself will cause an error of approximately 1% per 50° temperature differential.

Maximum temperature of air or gas limited to 700° F.

When velocity measurements have to be made accurately at conditions where a temperature differential exists, such as in measuring velocities inside hot air ducts, the Velometer reading correction can be made utilizing the following equation:

$$V_c = V_m \sqrt{\frac{t_o + t_m}{t_o + t_{amb}}}$$

Where

		English Units	Metric Units
V_c	Flow Velocity, corrected	ft/min	m/s
V_m	Flow Velocity, measured	ft/min	m/s
t_m	Temperature of test air or gas	°F	°C
t_{amb}	Ambient temperature	°F	°C
t_o	Absolute Zero temperature differential	460°F	273°C

(5) MAINTENANCE

GENERAL: Alnor Velometers require very little service except for replacement of O-Ring gaskets and cleaning or replacing the filter elements in the Range Selectors and in the Lo-Flow Probes. If any difficulties in the operation of the Velometer should develop, please contact immediately the nearest Alnor Sales Representative or Alnor Instrument Company. Do not return any instruments without written authorization from Alnor Instrument Company or an authorized Sales Representative.

IMPORTANT: Through normal wear the Range Selector Switch Plate may work loose. This looseness can be corrected by tightening the "Take-up" Adjustment Screw which is located between the two hose fittings on the Switch Housing Assembly (Refer to Range Selector drawings—page 13.)
A noticeable effort to change range will indicate proper tightness.

WARRANTY

The Seller warrants to the Purchaser that any equipment sold will be free from defects in material or workmanship. If, at any time within (1) year from the date of shipment, the Seller is notified of any such defect it will promptly correct it by either, at its option, repairing any defective part or material or replacing it. This warranty shall be effective only if installation and maintenance is in accordance with our instructions and written notice of a

defect is given to the Seller within such period. This warranty is exclusive. There is no other warranties, written, oral or implied, and no warranties which extend beyond the description on the face thereof; specifically, without limitation, there is no warranty of merchantability or fitness for any purpose. The liability of the Seller shall be limited to the repair or replacement of materials or parts as above set forth.

Alnor Velometers and Probes are provided with a seal. In cases where instruments or Probes are returned with the seal broken, the warranty is void. Velometers have one of the housing screws on the rear cover of the instrument sealed. The Pitot Probe and the Lo-Flow Probe have the micro adjuster on the head of the Probes sealed.

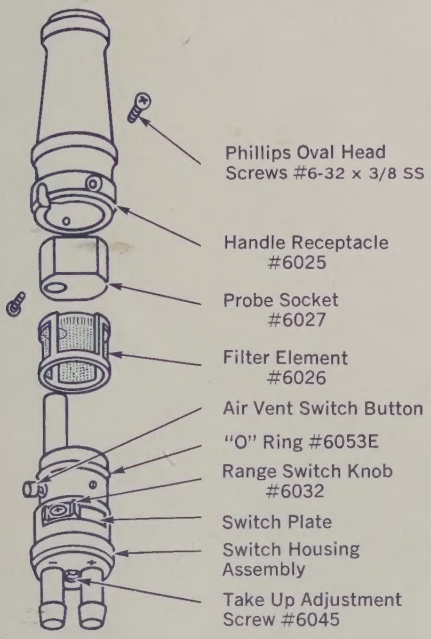
REPLACEMENT OF RANGE SELECTOR FILTER: In order to replace the filter of the Range Selector proceed as follows: (Refer to Range Selector drawing page 13).

Remove the two Phillips Head Screws on the collar above the Range Selector switch. Exert slight pressure to hold the upper and lower half of the Range Selector assembly together to permit easy withdrawal of the two screws. Carefully pull the upper and lower half of the Range Selector assembly apart. Withdraw the filter Part Number 6026. Carefully clean the filter element by means of a brush or vacuum cleaner, or wash in hand-warm water and grit-free soap. In case the filter element is damaged, replace it. Before reassembling the Range Selector, clean carefully all parts.

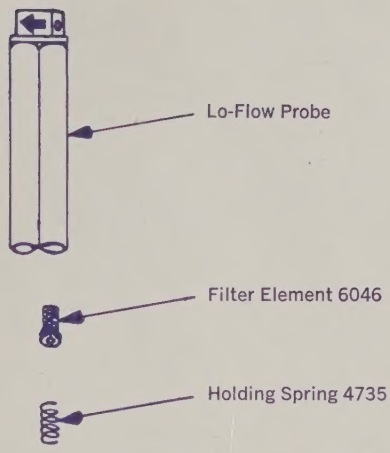
To install the cleaned or replacement filter, slip the bore of the filter over the protruding nipple portion of the lower Range Selector part. Place the filter element onto the lower Range Selector part with the open end of the cup-shaped filter adjacent to the filter bearing surface on the lower Range Selector part. Then slip the Probe socket over the protruding nipple portion. Carefully align all three outside diameters of the lower Range Selector part, the filter and the compression spacer. Slip all three parts into the upper Range Selector housing so that the Air Vent Switch Button protruding from the lower Range Selector Assembly aligns with the channel in the upper Range Selector Assembly. Exert slight pressure when inserting the Phillips Head Screw and lightly tighten both Phillips Head Screws.

REPLACEMENT OF FILTER ON LO-FLOW PROBE: In order to replace the filter element on the Lo-Flow Probe, remove first the holding spring by means of a screw driver or hook-shaped tool. Then withdraw the filter element. Carefully clean the filter element by means of a brush or vacuum cleaner, or wash in hand-warm water and grit-free soap. In case the filter element is damaged, replace it. Before reassembling clean all Lo-Flow Probe parts. Insert the cleaned or replacement filter Part Number 6046 by slowly moving it with the open end of the cup-shaped filter pointing away from the Lo-Flow Probe bore. Ascertain that the filter element seats properly. Follow the filter element with the retaining spring. Install the retaining spring utilizing a slightly twisting motion in clockwise direction by holding the spring with the finger. To finally secure the filter element in place, push the retainer spring firmly in place.

FILTER REPLACEMENT IN RANGE SELECTOR



FILTER REPLACEMENT IN LO-FLOW PROBE



REPLACEMENT OF O-RINGS IN PROBES: To replace the O-Ring in the Probes remove the O-Ring by means of a hook-shaped tool, or by squeezing. Clean the O-Ring groove before installing the new O-Ring. Slip the new O-Ring in place and apply a thin film of Silicone grease or lubricant on the outside of the O-Ring. The O-Ring Part Number 6053D fits all Velometer Probes.

REPLACEMENT OF O-RINGS ON VELOMETER: The O-Ring of the Velometer connection port can be replaced by removing first the old O-Ring using a hook or by squeezing, and then by slipping the new O-Ring Part Number 6053C in place. Before installing the new O-Ring the groove for the O-Ring should be cleaned. To provide access to the O-Ring under the fitting flange, (Part Number 6053B) unscrew the fittings. The single hose can be slipped over the fitting and be used as a driver.

CLEANING OF THE VELOMETER: In case it is necessary to clean the exterior of the Velometer, use a damp cloth or a cloth moistened with alcohol and wipe the exterior carefully. Do not rub excessively. Do not use carbon tetrachloride.

(6) REPLACEMENT PARTS AND ACCESSORIES

In case additional parts are required to convert one Velometer set into another one, or in case broken or damaged parts have to be replaced, the parts can be ordered from the factory. Since all parts are interchangeable and no specific calibration of Probes is required together with the particular instrument, it is only required to specify the Alnor Number of the desired replacement part or accessory.

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